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UNITED STATES ATOMIC ENERGY COMMISSION
RELAXATION LENGTHS IN LIGHT WATER
LATTICES (1.3% METAL)

By
Herbert Kouts

September 16, 1953

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M E M O R A N D U M

Date: 9/16/53

TO: Irving Kaplan

FROM: Herbert Kouts

SUBJECT: Relaxation Lengths
in Light Water
Lattices (1.3% Metal)

Attached are tables of the relaxation lengths measured for the first few new sets of light-water moderated lattices. For all these, the uranium enrichment was 1.3%, the fuel rod diameter was .600 inches, and the water-to-metal ratios varied from 4:1 to 1:1.

The experimental methods used were essentially the same as those listed in our report to the commission on the 1%, .750 inch diameter rod lattices.*

For this later work, though, we have measured a greater number of relaxation lengths, partly to improve statistical accuracy and partly to permit study of the change of reflector savings with loading radius.

For the measurements reported here we have had on hand more than a critical mass of uranium. Therefore loadings were made closer to critical, with correspondingly better accuracies. Because of the large relaxation lengths, end effect corrections had to be made to compensate for the sinh behavior of the flux near the upper boundary.

* BNL Log No. C - 6687

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The 1:1 water-to-metal ratio lattice was so compact that there was no room between the fuel rods for our standard foil rods. Therefore it was decided that we would measure the relaxation lengths with a foil rod in an empty fuel rod position (near the lattice center). The lattice was more reactive with the fuel rod removed, and so the relaxation length was greater than it would have been with the fuel rod in. We therefore had to relate the measured relaxation length to that loading with no empty channels which would produce it.

The number of rods for this fictitious loading was determined as follows: Two critical approach runs were performed, one with the channel in question empty, and the other with it filled by a fuel rod. The count rate of a strategically placed BF_3 counter was recorded in each case. Two loadings in the two geometries which gave the same BF_3 counter response had the same relaxation length. This put the loadings in the two geometries into 1:1 correspondence, and enabled us to relate measured relaxation lengths to the proper fully loaded lattices.

In other words, we measured a relative importance function for outside rods to inside rods as a function of loading. This importance function was negative, and ranged from 4 to 17 in value.

Because of this method of analysis, the rod loadings for the 1:1 lattice are, in general, not integers.

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Rod Size: .600"

Poison: 0

Enrichment: 1.3%

<u>1:1</u>		<u>1.5:1</u>		<u>2:1</u>		<u>3:1</u>		<u>4:1</u>	
<u>Rods*</u>	<u>L</u>	<u>Rods</u>	<u>L</u>	<u>Rods</u>	<u>L</u>	<u>Rods</u>	<u>L</u>	<u>Rods</u>	<u>L</u>
407.5	18.836	373	42.744	265	40.293	211	42.496	217	44.287
395.5	18.131	367	40.942	259	37.526	205	37.255	211	40.515
383.5	17.817	361	38.986	253	34.066	199	34.025	205	35.892
371	17.439	355	35.580	247	32.466	193	31.127	199	34.209
359	17.073	349	34.595	241	30.071	187	29.026	193	31.410
347	16.581	343	32.852	235	28.340	181	26.835	187	29.109
335	16.432	337	31.007	229	26.944	175	25.072	181	27.087
323	15.953	331	29.487	223	25.657	169	23.387	175	25.958
310.5	15.464	325	29.165	217	23.924	163	22.350	169	23.879
298.5	15.096	319	27.873	211	23.177	157	21.382	163	23.185
286.5	14.895	313	27.248	205	22.044	151	19.955	157	21.796
274.5	14.438	307	26.115	199	21.418	145	18.969	151	20.563
262.5	14.055	301	25.493	193	20.224	139	18.041	145	19.957
250.5	13.657	295	25.101	187	19.685	133	17.342	139	18.910
238.5	13.196	289	23.895	181	18.869	127	16.472	133	17.982
226	12.937	283	23.261	175	18.303	121	15.644	127	17.200
214	12.604	277	22.517	169	17.208	115	15.116	121	16.500
202	12.261	271	21.939	163	16.844	109	14.403	115	15.895
190	11.887	265	21.200	157	16.218	103	14.021	109	15.224
178	11.316	259	20.716	145	15.301	97	13.418	103	14.539
166	11.023	253	20.205	139	14.885	91	12.654	97	14.001
		247	19.449	133	14.308	85	12.177	91	13.368

* Theoretical number

-3-

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